

THE SURGICAL TREATMENT OF PULMONARY CAVITIES.¹

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THE surgical treatment of pulmonary cavities, with its proper limits and restrictions, is well worth serious discussion and careful consideration at this time; for, on the one hand, there is an undoubted tendency on the part of some to boldly push its application beyond the just limits of reason and safety; and, on the other hand, there is a hesitancy to admit its application to those cases where it has already been shown that it may be properly applied, and where experience has demonstrated that we possess no other adequate means of combating conditions which tend to a necessarily fatal termination.

A large number of experiments upon animals has unquestionably shown that considerable portions of the lung may be removed without serious impairment to health, and that the lung may be punctured with comparative safety, and that for this purpose local obliteration of the pleural sac may be induced by artificial means. These experiments have undoubtedly been of great service in establishing the possible extent of operative interference in man, and have determined many important steps in the methods and technique of these operations. Their comparative safety in animals and the possibility of avoiding fatal consequences by proper care and experience has, however, often led to conclusions beyond the limits of just deduction, and have justified operative interference beyond the proper bounds of prudence. Simply because a patient survives some operative inter-

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ference by no means proves that he is ultimately the better for it, or that the same end might not be better and more safely, even if more slowly, attained by other less hazardous means. The experimental work on animals, which has done so much for this department of surgery, has so often been fully described that it is not necessary to recall it in detail, except to offer the suggestion that here, as elsewhere, the work of the laboratory has proved a very insufficient basis for the actual work of the surgeon.

Peyrot, in his recent work on surgery, divides pulmonary lesions, in their relation to surgical interference, into two classes: (1) Limited or localized lesions, in which he includes gangrene of the lung, most abscesses and hydatid cyst; (2) diffused lesions, pulmonary cavities and bronchiectasis. This division is of practical importance for the purpose of this paper, for the complete removal of a limited lesion, if possible, relieves the patient of his trouble, and, if he does not succumb to the operative attack, restores him more or less fully to health; on the other hand, the removal of a local lesion in a generalized or diffused disease must of necessity be incomplete, and leave the general pathological state unchanged. Evident as this is, and of great importance to bear in mind the very subject we are considering, too much stress must not be laid upon it, for we are constantly confronted with cases where the influence of a local pathological lesion dominates the general state, and becomes the controlling factor in the dangerous conditions present. This is notably true in regard to tubercular cavities in the lung. The presence of foul decomposing secretions in these cavities give rise to a series of profound septic conditions, which materially aid in developing the general disease, while, by causing frequently recurring attacks of distressing cough, weaken the patient by loss of sleep and strength, and so materially diminish his resistance to the influence of the general tubercular trouble. Furthermore, the discharge of the foul-smelling secretions by the mouth often nauseates, and so diminishes the little capacity there is for taking the necessary food. This unfortunate circle of influences is due to the fact that there exists a focus of pent-up

secretions under conditions most favorable for putrefaction, and where the conditions are most unfavorable for disinfection, or the thorough removal of the *materies morbi*. If, now, surgical interference can remove or modify this local trouble, which is the direct cause of such serious consequences, and can so modify for the better the general condition of the patient, even if it does not control the other phases of the disease, it is not only justifiable, but strongly indicated. This course, indeed, is constantly pursued in other portions of the body, where operations are performed simply for the relief of suppurative processes which are sapping the strength of the patient. What surgeon would hesitate to drain or scrape out tuberculous abscesses in other parts of the body, which were accessible to interference, because there happened to be evidence of commencing disease in the lungs or tubercular foci elsewhere. The presence of such new and extending processes of disease call with increasing force for the removal of the source of septic infection. What applies to tubercular cavities applies also, but possibly with less force, to bronchiectatic cavities, for here we find much less frequently a single cavity so far in advance of the dilatation more or less diffused, as to be the evident cause of the septic state from its retained secretions.

As to the efficiency of operative measures in these cases, Powell, in the last edition of his work, bears strong testimony. In speaking of a case in which a bronchiectatic cavity had been opened and drained, he says: "I was much struck at the extraordinary effect draining of the cavity had upon the cough and expectoration. The amount of expectoration was reduced from 16 to 20 ounces a day to almost nothing."

Because the conditions favorable to operation are not present in the majority of cases of bronchiectasis, or because they are rarely found, is no reason for withholding the operation when a favorable opportunity does occur. The results which have thus far been attained by surgical interference in pulmonary cavities, have been to provide free drainage and disinfection of cavities and abscesses, and the removal of gangrenous masses and foreign bodies.

The propriety of operative interference depends, therefore, upon the possibility of accomplishing these aims, and upon the danger of the operation, and, further, upon the presence of a septic condition dependent upon the local cavity or lesion, and, finally, as to whether other forms of treatment have been satisfactory and successful. This last element in the problem may, I think, be readily disposed of. "All attempts," says Shurley, "to modify or disinfect lung cavities by injection or disinfection, have proved in the vast majority of cases ineffectual." That foul and decomposing secretions found in pulmonary cavities are, in themselves, most hurtful, and modify most unfavorably all forms of chronic lung disease, is so universally admitted that it is not necessary to prove it by specific authority.

In the following paper I shall confine myself to the opening and draining of pulmonary cavities, and pass without further consideration those daring attempts, based largely upon experiments in animals and false pathological analogies, in which portions of consolidated lung have been removed. Tuffier, indeed, has reported a case where a solid apex was successfully removed from a man of twenty-five, and Watson, more recently, another, where an infiltrated mass as large as a fist was taken away by an operation most ingeniously conceived. In spite of such isolated success, the time has certainly not yet come when the words of one of our most advanced surgeons, words spoken, indeed, before the State Society of this very State, eight years ago, can be said to have become prophetic, when, in speaking of Bloch's case of pneumonectomy of tubercular disease, he said: "While I would not say that we are just yet prepared for this sort of thing, I would not be surprised at its attempt by some venturesome spirit, nor condemn it, and I look forward to the time, perhaps just before the millennium, diagnosis and technique having in the meantime been perfected, when excision of the tuberculous apex may be the recognized treatment." Peyrot, in his recent work, condemns these operations most strongly: "I would say, most willingly, with Koenig, that to practice these operations one must ignore all the acquired knowledge of pathology, and that we ought to protest against such wholly unjustifiable attempts."

The various forms of pulmonary cavities which come under the care of the surgeon for operative interference, may be enumerated: (1) Abscess of the lung, pulmonary gangrene and hydatid cyst; (2) tuberculous cavities, bronchiectatic cavities and pyopneumothorax. The second class presents much the largest number of cases in which the question of operation will have to be considered, and here also we find the greatest difference of opinion as to the propriety and efficiency of surgical interference.

Turning now to the treatment of tubercular cavities, it will be of interest and profit to know what some of the recent systematic writers, who view the matter from a medical standpoint, have to say upon this subject. Douglas Powell says: "That surgical treatment in phthisical cavities offers little prospect of advantage, because, first, cavities are usually situated at the apex, and their drainage *per vias naturales*, by the bronchia, is fairly maintained, so that interference is not often called for. Secondly, cavities are not often single with any activity of symptoms; and, third, excavation in phthisis is a conservative process so far as it results in removal of morbid materials, that are far more injurious than vacuity. Half the history of phthisis is made up of this elimination process, with which the hectic phenomena are identified, and with the accomplishment of which they cease, if the perfected elimination be not overlapped by activity of process in other centres. Hence, pulmonary surgery, in regard to phthisis, has not, I fear, a hopeful future." "But," he continues, "cases now and again present themselves in which the extent of the excavation, superficialness of cavity, restriction of disease to one side and a large amount of secretion, strongly suggest external drainage." This is a very concise statement of the case, and one which fairly offers encouragement for the surgeon in properly selected cases.

Exaggerated claims for operative interference are to be most strongly deprecated; but in a certain number of cases, as practically admitted above, the conditions are such that operation for the purpose of external drainage is justified and demanded. Burney Yeo writes in much the same strain: "It is doubtful if

ordinary phthisical cavities will ever admit of successful surgical interference, either by drainage, injection or aspiration. It is exceedingly rare in phthisis to find a single cavity without adjacent lesion, and most commonly there is an extensive surrounding pulmonary disorganization, so that whatever alleviation of particular symptoms (profuse or foetid exudation, for example) might occur, it could only be temporary." Shurley, who has such undoubted confidence in the form of treatment in phthisis introduced by himself and Gibbes, has recently reported two cases of advanced disease, in which pulmonary cavities were treated by incision and the inflation of the cavity with chlorine gas, and, while neither of these cases proved successful, he advocates further efforts in this direction, to secure free drainage and to bring into contact with the tubercular tissue of the walls this agent, in whose destructive action upon the bacillus tuberculosis he has so much confidence.

In this connection I desire to report the following personal experience :

B. S., aged twenty-nine, well developed and fairly nourished, entered the Cincinnati Hospital September, 1892. His father died of phthisis, and most of his relatives have died of the same disease. He has had the ordinary diseases of childhood, and in addition gonorrhœa and pneumonia, but denies syphilis; he admits free drinking. Patient says he had rheumatism all of last year, and last March he was in the hospital with symptoms of chronic inflammation extending along the entire ascending colon, and since then he has always been sick. Patient came to the house complaining of severe pain on the right side upon inspiration, with dyspnœa and a continued dry cough. Appetite good, bowels regular, and tongue normal, pulse 108, temperature 99.4 degrees. Physical examination showed some diminution of expansion on the right side of chest. Palpation negative. On percussion there was dullness on the right side, as high as the seventh rib in front and to the angle of the scapula behind, and diminished resonance at the apex. Auscultation negative on the left side; there is a roughened and prolonged expiration upon the right side, at the apex, and tubular breathing anteriorly, at the seventh rib, and weak, moist, nearly inaudible sounds below.

Soon after admission, Dr. Oliver, then on duty in my absence,

introduced a hypodermic and drew off some bloody fluid, which, on microscopic examination, failed to reveal any pus corpuscles, and on this score he expressed a doubt as to the presence of empyema, which had been asserted, and gave his opinion that a cavity of the lung existed. The general condition of the patient was such as to keep him constantly in bed for several weeks after his admission; the local condition remained unchanged. He was then submitted to operation, and three inches of the eighth and ninth ribs were removed in the axillary line, and the underlying cavity freely opened, and about half-a-pint of blood-stained purulent fluid mixed with the debris of broken-down tissue and caseous material evacuated. Over this cavity the pleural surfaces were firmly adherent and the cavity reached to the surface of the lung. The walls of this cavity were rough and irregular, as in ordinary phthisical cavities, and a large portion of the lower lobe was excavated. The cavity was washed out with a sterilized boracic solution, the skin incision partly closed, and a double drainage-tube left in place. The discharge at first was very free, but soon diminished, and the drainage-tube was abandoned after some days, and the incision readily healed. The general condition at once improved, and the man was soon up and about the house. The area of dullness diminished, but did not entirely disappear, and the respiratory sounds could be heard at a much lower level than before. The condition of the right apex remained unchanged. This man left the hospital in about two months, and since then nothing has been heard from him.

This case presents the type of lung cavities most accessible and most favorable for operation—obliteration of the pleura over a superficial basic cavity of considerable size, in a patient not too much debilitated, and whose general nourishment has not already suffered. In such cases the operation presents no difficulty and but little danger, and few if any would hesitate to recommend it. It is unfortunate that the case could not have been kept under observation sufficiently long to determine the course of the disease in the right apex. In cavities at the apex of the lung the operation is necessarily more difficult from the relation of the parts, but even here Poirier finds that it is easy of performance, and secures very efficient drainage. Their situation offers the condition favorable for freer drainage by the bronchi, so that

there is less likelihood of secretion being retained and undergoing putrefaction. Still, this condition does occur, and where sufficiently prominent the operation should be undertaken, and there is good prospect of benefit and even of cure. Poirier and Jonnesco, in their report to the Congress for Tuberculosis, Paris, 1891, report that twenty-nine operations in cavities of the apex gave four cures, fifteen were benefited, nine without results and one unknown. A study of the general statistics of the operations on lung cavities of both apex and base present curious contrast.

Hofmohl reports twenty-four cases with five cures, five unimproved, nine deaths and three unknown. Lopez, thirteen cases, thirteen deaths. Slawitz, thirteen cases and three cures. Seitz, eleven cases and five cures.

Such results are certainly not without encouragement when the benefits of diverting the foul discharges are remembered even if a cure does not result, and contains in itself a refutation of the condemnation which has been expressed against surgical interference in tubercular cavities. The objection which has been urged against operation in bronchiectasis—that the dilatation is never confined to a single portion of the bronchial tube is certainly true of the majority of cases, but it is also certainly true that at times we meet with single cavities from this cause, so much larger and so far in advance of all others that they can be readily located, and which undoubtedly furnish the great mass of the putrid expectoration from which the patient suffers. In such cases Powell speaks in hopeful and approving manner of operative measures. I have quoted him above as to the benefit to be expected by marked diminution of the quantity of expectoration. He further adds: "When the area of disease is definable and the patient's health is becoming undermined in spite of all the resources of medicinal and climatic treatment, operative measures may be devised, and I believe good may be effected, although the cavity or area of excavation be not thoroughly drained, by setting up contractile changes in the tract of the tube," and this favorable opinion he considers supported by actual statistics of the operations thus far reported. Findley reports five cures and fifteen deaths in twenty cases. Lopez, four cures and eight deaths

in twelve cases. Hofmokl, no cures, eight deaths, one unimproved and three unknown in twelve cases. The average operation in bronchiectatic cavities is likely to be much more difficult and dangerous than in a like number of tubercular cavities, for the latter are much more apt to be superficial with adherent pleura, so that the danger of cutting through lung tissue will be avoided. Still, both Burney Yeo and Powell speak with approval of surgical interference in appropriate cases.

In cases of abscess, gangrene and hydatid cyst of the lung there seems to be a growing unanimity of both medical and surgical opinion that an attempt to drain and evacuate these cavities ought to be made. Abscess of the lung may occur as the result of septic emboli, when they are likely to be small and scattered throughout the organ. These do not fall within the range of operation. "Abscess formation is frequent in the aspiration forms of pneumonia. They vary in size from a walnut to an orange, and have ragged and irregular walls and purulent, sometimes necrotic contents" (Osler).

Foreign bodies may cause abscess by penetrating the wall or by being drawn in through the trachea. In most, if not all, the cases reported from the latter cause the foreign body has been accidentally discovered when the abscess was opened; finally abscess may break into the lung from neighboring organs. In individual cases the question of operation would depend simply upon the possibility of diagnosis and the definite location of the abscess, for all admit the extreme gravity of this condition when left to nature. Huber has advised against the attempt during the existence of an acute pneumonia, and this has been the course in the majority of cases reported. Lopez has reported fourteen cases of abscess of the lung submitted to operation, with twelve cures, one death and one case the result unknown. Hofmokl, forty-two cases, fourteen complete cures, three with fistula, twenty-four deaths and one unknown. The question of how far the operation was responsible for the fatal cases cannot be determined from these statistics. Spontaneous evacuation through the chest wall sometimes occurs, but the drainage in these cases is seldom sufficiently free to insure a perfect cure, and fistulous

tracks often remain open, and finally determine a fatal result. The following case bears upon this point :

Case of Pyopneumothorax with a Bronchial Fistula Relieved by Resection of Rib and Opening and Draining of Cavity.—In March, 1891, I was called to see the patient by a friend, who was temporarily in charge during the absence of the regular physician. The condition I found was as follows : There was an opening between the seventh and eighth ribs on the left side in the axillary line, from which a foul-smelling discharge escaped, and through which air was forced with jets of putrid matter during the fits of coughing, which occurred at short intervals. Large quantities of purulent matter were expectorated from time to time. A probe was found to pass readily through the fistula, upwards and inwards, and at the depth of three inches entered a cavity of apparently considerable size. The connection of this cavity with a bronchial tube of large calibre was unmistakably demonstrated by the manner in which air and pus were forced through the external opening during the spells of coughing. A carbolic solution, which was used to wash out the cavity, was immediately tasted after being introduced, and always provoked coughing, with expectoration of a quantity of matter smelling of carbolic. The heart was somewhat displaced to the right, and the upper part of the left side anteriorly was depressed. The respiratory sounds could be heard over the upper part of the lung in front and throughout the back. The right lung appeared normal. It was evident that the cavity on the left side contained a quantity of foul, decomposing pus, for which there was a very inadequate escape either through the bronchus or by means of the external fistula. The symptoms all indicated a profound septic condition. Severe and distressing chills occurred at short intervals, with high temperature and exhausting coughing spells, and for some days when first seen the man had been growing rapidly and progressively worse. The early history of this case, which it was possible to obtain, is somewhat meagre.

In January, 1890, more than a year previous, the patient had suffered from an attack of pneumonia, from which there was consolidation of nearly the whole left side. In March an abscess pointed and was opened on the anterior aspect of the chest, and proved to be connected with the interior of the thorax. His physician at that time was uncertain as to whether this was due to an abscess of the lung or an empyema. There was no pneumothorax at this time, and

the date when this occurred could not be definitely determined. The man's condition when I saw him was such that it was evident death must soon ensue unless he could be promptly relieved of the constant absorption from the putrid pus in the badly-drained cavity. It was determined, therefore, to freely expose and empty this cavity and attempt its thorough disinfection. A large section of the sixth, seventh and eighth ribs was removed through the antero-lateral aspect of the chest. The pleural cavity was obliterated and the pleura greatly thickened. The fistulous track was traced upwards and inwards with a large grooved director, and with this as a guide a large cavity was laid open with the thermo-cautery. The cavity was of large size and contained an amount of decomposed pus. The tissues covering it, which were cut through with the cautery knife, were of a dense fibrous structure and had lost all characteristics of lung tissue. This was freely destroyed by the cautery, and the cavity was irrigated and a large-sized drainage tube left in place. The improvement began at once, the septic condition disappeared and in a few weeks the man was able to be out, and was soon restored to comparative health. The fistulous opening in the side has, however, never completely closed, but all evidence of connection with the bronchial tube quickly disappeared, and if the patient had permitted the proper means to be continued in order to secure sufficient drainage, a definite cure might have resulted. He was, however, irascible and unreasonable, and would not tolerate the presence of a drainage tube. As it is, however, he has enjoyed nearly two years of comparative health and comfort. He is now, I understand, beginning to show amyloid degeneration of some of the inner organs. Whether or not in this case there was originally an abscess of the lung there may be, possibly, some doubt. Certainly at the time of the operation a considerable cavity was found within the limits of the lung, from which there was free communication with a bronchus of large size.

In these cases of bronchial fistula free removal of ribs will probably always be necessary, and the fistulous track should then be freely laid open until the cavity is reached, and for this purpose the thermo-cautery is certainly the best instrument. In this way a cavity, if it exists, can be more certainly drained, and if none exists, any irregularity in the fistulous track itself, which may prevent the ready escape of the discharges, be removed.

In local gangrene operation affords the only practical chance, and, when the disease can be located, the cavity should be opened freely enough to permit the removal of the gangrenous mass. The suggestion made by Delageniere, that the entire section affected should be exsected, is not to be approved of, although he claims that in these cases "failure is due to the fact that gangrenous foci have only been opened and drained, and thus all the gangrenous tissue has not been fully removed."

Of the result in gangrenous cases, Lopez reports seventeen cases of gangrene treated by opening the cavity, followed by ten cures, six deaths and one case unknown. Hofmohl, twenty-four cases, five cures, one unimproved, thirteen deaths, two unknown.

Hydatid cysts give the larger number of cures where pneumotomy has been done, and the greatest percentage of recoveries. It has become a recognized procedure among the English surgeons of Australia, both before and after suppuration has occurred. Hofmohl and Lopez give, respectively, forty-five cases with thirty-seven cures, and thirty-six cases and thirty-one cures, certainly a most gratifying result."

The operation of pneumotomy may be extremely simple or may involve very great difficulty. The difficulties depend upon whether adhesions have closed the pleural cavity where the opening is to be made, and the depth in the lung at which the cavity is situated. If situated any distance beneath the surface it may be easily missed by the knife or trochar, and the necessity for cutting through normal lung tissue certainly exposes to the risk of hæmorrhage and increases the danger of infection. It is of importance, then, to determine in all cases whether adhesions of the pleural surface have taken place or not. The introduction of the sterilized needle through the chest wall is said to indicate this with certainty. If adhesions have not taken place, movement of the pleural surfaces upon one another will be indicated by free movement of the free end of the needle. The value of this method is accepted by a number of writers upon this subject. It may be a question as to whether partial consolidation of the lung might not so limit the pleural movement as to render it inoperative. The size and depth of the cavity it is of

importance to determine if possible. Godlee says that the amount of discharge by the mouth is no indication at all of the size of the cavity. He has known cases where a pint was daily expectorated in which the cavity would not contain an ounce. Shurley has emphasized the difficulty of determining with certainty the location of cavities and the distinguishing of pulmonary excavations from locular collections in the pleural cavity, or of distinguishing bronchiectatic cavities from others. "I believe," he says, "it well nigh impossible with certainty to determine the perspective, so to speak, of a pulmonary cavity; that is, whether it be half an inch, or two or three inches, from the surface, with or without much intervening pulmonary parenchyma." Before any operation is undertaken the existence of a cavity should certainly be ascertained by the introduction of a large-sized aspirator needle, and its depth determined, so far as the uncertain thickness of the thoracic wall will allow. And, at the time of the operation, puncture should again be made, after the costal pleura has been exposed. The lung may thus be punctured safely in various directions, a number of times, until the cavity is reached and its depth accurately determined. The canula held in place is a ready guide for the cautery or knife. It has, indeed, been suggested to have the canula grooved in order to facilitate its use for this purpose. The opening of cavities at the apex is more difficult, and from the relation of the parts, likely to be more dangerous than in the base. Poirier and Jonnesco have minutely described the steps of this operation, and their description is worthy of being followed. The first intercostal space has an average breadth of two centimetres. The incision commences in the middle of the sternum, four centimetres, the thickness of two fingers, below the supra-sternal notch, and follows the interspace nine centimetres. This incision is made with the thermo-cautery, and includes the skin and subcutaneous tissues. The fibres of the pectoralis major, which are seen, are separated by a grooved director. At the outer angle of this wound the anterior thoracic artery and vein may be seen, and at the inner, the internal mammary vessels, a centimetre from the edge of the sternum. The space between is six centimetres. The intercostal pleura is laid bare by a careful incision

of the intercostal muscle. The presence of adhesions of the pleural surface can now be readily determined. If they are not present the transparency of the pleura allows the movement of the underlying lung to be seen. If present the pleura appears thickened, resistant and of a dull white color, and conceals the lung surface underneath. Any uncertainty, however, can be removed by the introduction of a needle, and observing whether movement occurs in the free end. If adhesions are present, the cautery knife is used and made to penetrate the tissues in a direction slightly upwards and backwards. The cavity should be freely opened, and it is often necessary, in order to reach it, to pass through some thickness of tissue which is studded with tubercle. If adhesions are not present the perforation of the lung is postponed for several days. Resection of the rib is deemed generally unnecessary. There is decided advantage in commencing the incision in the middle of the sternum, for this permits of free separation of the edges of the wound and so gives greater space for the deeper manipulations. In order to approach the lung from behind, the incision commences from the seventh cervical spine, and extends to the internal superior angle of the scapula, passing through the skin and trapezius. The fibres of the rhomboideus are separated and the posterior third of the second rib is exposed. Four centimetres of this are removed and the pleura laid bare. This latter operation is reserved for exceptional cases, and I have not been able to find any report where it has been done in actual practice. The operation thus described should be practiced in cavities at the apex, except that the knife may be well used instead of the cautery in the superficial incision, and the section of rib may be made if found necessary to secure sufficient room. The scapular region must be for the present considered beyond the reach of surgical interference. Whether it will remain so time alone will tell. For the rest of the lung, especial care should be exercised to see that the puncture falls at the point where the symptoms of cavity are the most pronounced, and of the greatest intensity. Otherwise, the cavity may be entirely missed. A preliminary puncture should always precede operative interference. The incision through the

thoracic wall should be made with care until the parietal pleura is reached and the question of adhesions determined. Resection of ribs is usually advisable, and a sufficient number should always be removed to permit of free opening and full exploration of the cavity with the finger.

Most writers object to the washing out of the cavities with any kind of fluid, and advise their being packed with dry gauze. In this I think they have gone too far. A gentle stream of water, if free escape is allowed, would seem to be the safest and readiest method of removing secretions, often tenacious, and the débris of dead tissue, with the caseous masses, which are not infrequently found. Distention of the cavity must be most carefully avoided. I must deprecate mopping or swabbing the walls with dry gauze, however gently it is done, as liable to produce bleeding, and open the door to infection. Bleeding may occur from two sources: First, the walls of the cavity, and, second, the overlying tissue cut through by the knife. Spurting vessels should, of course, be seized, if possible, and tied. In the bottom of the cavity with friable walls, this will not, however, often succeed. Packing with simple or iodoform gauze is usually successful. The best preventive for bleeding along the incision is the use of the cautery in puncturing the cavity. This track may be enlarged, if necessary, by the same agent, or by the use of forceps, which are introduced closed, and subsequently opened. The knife should not be used to open the pleura, or penetrate the cavity, unless the latter is very superficial, and the former most certainly obliterated. If the pleural surfaces are not united, the opening of the lung should be, if possible, delayed. Adhesions may be induced by simply packing the wound with gauze, or by sewing the lung to the thoracic wall. Godlee, as far back as 1888, showed that the latter was feasible, but very difficult. It has been done, but how often successfully it is impossible to say. Cases have been reported in which an empyema has promptly resulted after opening the lung where the pleura had been stitched together. Immediate opening in these cases should be avoided if possible, as this method of attaching the surface is by no means a satisfactory and safe barrier against the escape of the

contents of the cavity into the pleura. In cases of pyopneumothorax, if the track through the lung can be traced, this should be enlarged with the cautery, using a grooved director as a guide. In this way any cavity or dilatation may be exposed, and irregularities of the track destroyed. The depth to which it will be safe to follow up these tracks time alone can tell. Treated in this manner there is a reasonable expectation that any communication with a bronchus will be permanently closed. The method adopted in one case, with bronchial fistula, by Guermontprez, is not to be commended. The opening in the pulmonary pleura was found after an excision of a number of ribs, and was then closed, and a slow convalescence ensued. Such a procedure would not be without danger, and would probably result in the retention of secretions, and a probable subsequent opening of the fistulous track. We may quote here with approval the suggestion of Thompson, of Manchester. In cases of empyema he advises the removal of ribs, and, after the escape of the pus, he explores the surface of the lung, and if any irregular indurated spots are found on the surface, he lays them open with the thermo-cautery. In this way tubercular foci, or superficial abscesses may be dealt with.

CONCLUSIONS.

The above study justifies the following conclusions:

- (1) A certain number of lung cavities can be successfully dealt with by incision and drainage.
- (2) Tubercular cavities in the lower portion of the lungs—if single and superficial, and the general condition of the patient permits—should always be opened. Cavities at the apex should only be opened where free and persistent foetid expectoration is present, and has resisted treatment, and the rest of the lung is not involved.
- (3) Abscess, gangrene and hydatid cyst should be opened and drained whenever they can be located.
- (4) Closure of the pleura should be present before evacuation of a cavity is attempted.
- (5) In cases of pyopneumothorax the fistulous track

should be explored, and any cavity freely laid open by the cautery.

(6) Cavities that have been opened are best treated by packing with gauze preferably iodoform.

(7) The further careful trial of such agents as iodoform, chlorine gas, and chloride of zinc, is desirable to determine as to whether the tubercular infiltration may not be modified by them.

(8) It is very desirable, for the further extension of surgical interference in pulmonary cavities, that the means of locating such cavities, and of determining their size, and the exact character of the tissue that overlies them, should be perfected by further study, and for the accomplishment of this the surgeon must look to the physician.